THE LONG-RUN DETERMINANTS OF INVESTMENT: A DYNAMIC APPROACH FOR THE FUTURE ECONOMIC POLICIES

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Abstract:

Investment is the sum of the purchases on newly produced capital, changes in business inventories referred to as inventory investment, and the purchases of new residential housing. The work covered by this study aims to identify the model that presents, in the best possible way, the method of investment's calculation and to determine the factors of influence. In the first part, the investment is analyzed as a linear function dependent on the interest rate; and the second part implies a new model for determining long-term investments, but also an identification of the measures that would lead to increased investments.

Keywords: *investment, interest rate, tax rate, fiscal policy*

1. Introduction

Of all the economic fluctuations in world history, the one that stands out as particularly large, painful, and intellectually significant is the Great Depression of the 1930s. During this time, the United States and many other countries experienced massive unemployment and greatly reduced incomes. In the worst year, 1933, one-fourth of the U.S. labor force was unemployed, and real GDP was 30 percent below its 1929 level. This devastating episode caused many economists to question the validity of classical economic theory

Classical theory seemed incapable of explaining the Depression. According to that theory, national income depends on factor supplies and the available technology, neither of which changed substantially from 1929 to 1933. After the onset of the Depression, many economists believed that a new model was needed to explain such a large and sudden economic downturn and to suggest government policies that might reduce the economic hardship so many people faced.

Keynes proposed that low aggregate demand is responsible for the low income and high unemployment that characterize economic downturns. He criticized classical

theory for assuming that aggregate supply alone—capital, labor, and technology—determines national income. (Mankiw, 2009)

This paper aims to identify the factors determining the investment in a large economy, in this case the U.S. economy. In aggregated equilibrium models, the equilibrium condition between global supply and global demand is I = S. In the analysis of the consumption function, from Keynes's fundamental law, the investment is considered to be exogenous. The Keynesian cross is only a stepping-stone on our path to the *IS–LM* model, which explains the economy's aggregate demand curve. The Keynesian cross is useful because it shows how the spending plans of households, firms, and the government determine the economy's income. Yet it makes the simplifying assumption that the level of planned investment *I* is fixed. An important macroeconomic relationship is that planned investment depends on the interest rate *r.* To add this relationship between the interest rate and investment, we write the level of planned investment as

$$I = I(r).$$

This investment function is graphed in panel (a) of Figure 1. Because the interest rate is the cost of borrowing to finance investment projects, an increase in the interest rate reduces planned investment. As a result, the investment function slopes downward (Mankiw, 2009).

To determine how income changes when the interest rate changes, we can combine the investment function with the Keynesian-cross diagram. Because investment is inversely related to the interest rate, an increase in the interest rate from $r1$ to $r2$ reduces the quantity of investment from $I(r1)$ to $I(r2)$. The reduction in planned investment, in turn, shifts the planned-expenditure function downward, as in panel (b) of Figure 10-7. The shift in the planned-expenditure function causes the level of income to fall from $Y1$ to $Y2$. Hence, an increase in the interest rate lowers income. The *IS* curve, shown in panel (c) of Figure 10-7, summarizes this relationship between the interest rate and the level of income. In essence, the *IS* curve combines the interaction between *r* and *I* expressed by the investment function and the interaction between *I* and *Y* demonstrated by the Keynesian cross. Each point on the *IS* curve represents equilibrium in the goods market, and the curve illustrates how the equilibrium level of income depends on the interest rate. Because an increase in the interest rate causes planned investment to fall, which in turn causes equilibrium income to fall, the *IS* curve slopes downward.

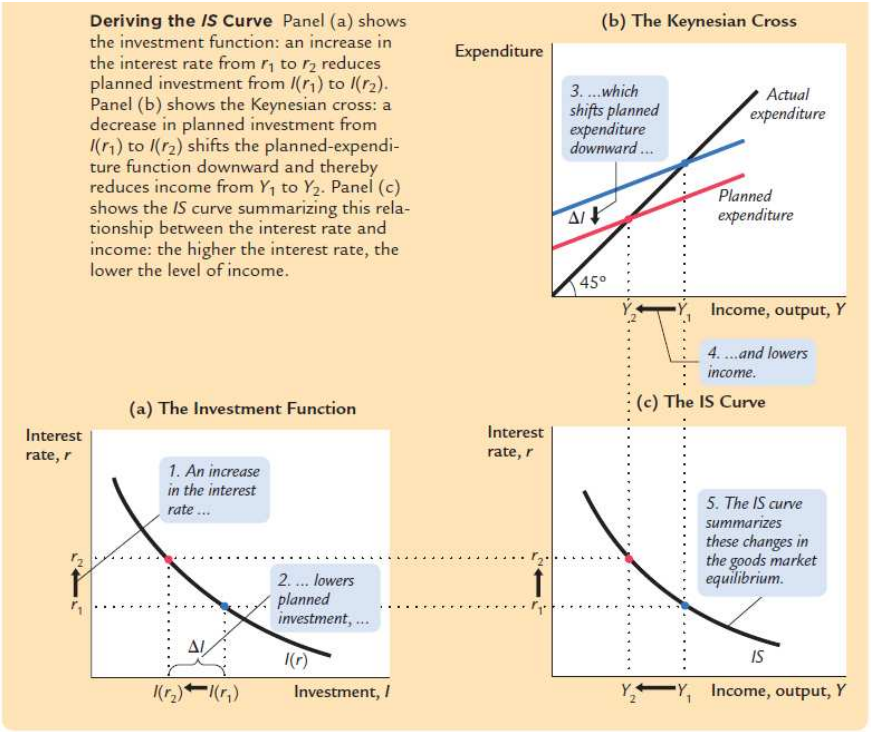

Figure 1. Deriving the IS Curve (Mankiw, 2009)

2. Data and methodology

In the following section, the theoretical model, proposed by the economic theory, will be analyzed, and after the validation process, a new model for determining long-term investments will be proposed.

Based on the model presented above, the investment function will be established, and afterwards the validity of the model will be checked. In order to obtain this new model, the regression model will be used, based on empirical data provided by the Federal Reserve Economic Data FRED ®. In the analysis, quarterly data from 1948Q1-2010Q3 was used, and the processing of the information was achieved in Eviews program.

The Identification of the Linear Regression Theoretical Model and the Verification of the Model's Validity

In the following section the investment equation is presented, based on the equation offered by the model:

$$I(r) = I_0 + i^*r, \qquad I_0 > 0 \text{ and } i < 0$$

where I(r) – investment, I_0 – autonomous investment, i – investment sensitivity to interest rate change, r – interest rate

After applying the linear regression model of the historical data, the following investment equation is obtained:

$$I = -12.7895*r + 754.3386$$

Table 1: The Investment Regression Equation

Dependent Variable: I
Method: Least Squares
Sample: 1948Q1 2010Q3
Included observations: 251

Variable	Coefficient	Std. Error	t-Statistic	Prob.
R	-12.78958	14.92222	-0.857083	0.3922
C	754.3387	81.30221	9.278206	0.0000

R-squared	0.002941	Mean dependent var	695.5841
Adjusted R-squared	-0.001063	S.D. dependent var	692.1522
S.E. of regression	692.5199	Akaike info criterion	15.92649
Sum squared resid	1.19E+08	Schwarz criterion	15.95458
Log likelihood	-1996.774	Hannan-Quinn criter.	15.93779
F-statistic	0.734590	Durbin-Watson stat	0.003787
Prob(F-statistic)	0.392223		

After analyzing the equation obtained, the following conclusions arise:

- Prob (F-statistic) = 0.3922> 0.05, indicates that the model is not statistically significant
- R-squared = 0.0029 and Adjusted R-squared = -0.0010 show a reduced intensity of the connection between interest rate (r) and investment (I)
- t-Statistic for the R parameter has Prob = 0.3922> 0.05, illustrating the fact that the parameter is not significant

Thus, after verifying the validity of the model, it can be stated that it is not valid, and that the investment is not a linear function of the interest rate.

Achieving the Investment's Function

Investment is the component of GDP that links the present and the future. Investment spending plays a key role not only in long-run growth but also in the short-run business cycle because it is the most volatile component of GDP. When expenditure on goods and services falls during a recession, much of the decline is usually due to a drop in investment. Economists study investment to better understand fluctuations in the economy's output of goods and services. The models of GDP, such as the IS–LM model, were based on a simple investment function relating investment to the real interest rate: I = I(r). That function states that an increase in the real interest rate reduces investment (Mankiw, 2009). The global investment sum is tied, by Keynes, to the interest rate, and the investment decision belongs to the manufacturer,

who decides whether or not to convert amounts of money in physical assets, production goods (Frois, 1994).

Next, in this paper, the investments' function will be achieved, and also factors determining the investments will be identified. There are three types of investment spending. Business fixed investment includes the equipment and structures that businesses buy to use in production. Residential investment includes the new housing that people buy to live in and that landlords buy to rent out. Inventory investment includes those goods that businesses put aside in storage, including materials and supplies, work in process, and finished goods (Mankiw, 2009).

Based on these investment categories, the endogenous variables of the investment function were identified. The three types of investments are expressed below:

- Business Fixed Investment = f (marginal product capital, interest rate, taxes)
- Residential Investment = f (interest rate, demographic growth)
- Inventory Investment = f (interest rate, business cycle)

In this situation, for starters, the investment function will be defined, which depends on several factors:

I = I (MPK, r, Taxes, demographic Growth, GDP Growth)

Table 2: The Partial Correlations

	I	Demographic growth	GDP growth	MPK	R	T
I	**1**	**0.26**	**-0.21**	**-0.26**	**-0.05**	**0.98**
Demographic growth	0.26	1	0.09	0.03	0.25	0.23
GDP growth	-0.21	0.09	1	0.98	0.22	-0.25
MPK	-0.26	0.03	0.98	1	0.09	-0.28
R	-0.05	0.25	0.22	0.09	1	-0.12
T	0.98	0.23	-0.25	-0.28	-0.12	1

(Source: Personal Computation)

After the analysis of the partial correlations, the variables *demographic growth, GDP growth* and *MPK* will be eliminated from the upcoming evaluation, due to low correlation coefficient between the investment and these variables (the relationships' intensity between the exogenous variables and the endogenous variables were very low). But the interest rate is kept for further analysis, because it represents one of the most important instruments of economic policy. In relation to the taxes, these are dependent on the national income's volume, so, in order to achieve a better approach for economic policy, the tax rate will be used as a ratio between taxes and income.

After implementing the multicollinearity test, achieved using the Klein criterion and inflation factor criterion, the following results have been obtained:

Table 3: The Multicollinearity Tests

Applied Criterion	Results	Conclusion
Klein Criterion	$R^2 = 0.6413 > R_{x/y} = -0.0273$	R and TR are not collinear
Inflation Factor Criterion	$F_r = 0.9993$ $F_{TR} = 0.9993$	R and TR are not collinear

(Source: Personal Computation)

After eliminating the insignificant endogenous variables and after the implementation of the of multicollinearity test, the following investment function was achieved:

$$I(r, TR) = I_0 + i_r*r + i_t*TR, \; I_0 > 0$$

where r – interest rate, TR – tax rate, i_r – investment sensitivity to interest rate change, i_t – investment sensitivity to tax rate change, I_0 – autonomous investment

After processing the empirical data, the next multiple regression for the investment function was established:

$$I = 7072.95 - 17.94*R - 22323.88*TR$$

Table 5: The Investment Regression Equation

Dependent Variable: I
Method: Least Squares
Sample: 1948Q1 2010Q3
Included observations: 251

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7072.952	304.6822	23.21419	**0.0000**
R	-17.94857	8.971191	-2.000690	**0.0465**
TR	-22323.88	1062.521	-21.01029	**0.0000**

R-squared	**0.641342**	Mean dependent var	695.5841
Adjusted R-squared	0.638449	S.D. dependent var	692.1522
S.E. of regression	416.1847	Akaike info criterion	14.91202
Sum squared resid	42955997	Schwarz criterion	14.95415
Log likelihood	-1868.458	Hannan-Quinn criter.	14.92897
F-statistic	221.7332	Durbin-Watson stat	0.172816
Prob(F-statistic)	**0.000000**		

The analysis of the model shows that investments are in an inverse proportion relationship with interest rates and with tax rates.

The Verification of the Proposed Model's Validity

After testing the validity, through the F test, the following two conclusions arise:

- $F_{calc} > F_{tab,}$ indicated that the model is statistically significant (valid)

- Prob(F-statistic) = 0.00, indicated that the model is valid for a probability of 100-0 = 100%

Giving the R-squared of 0.6413 and the Adjusted R-squared of 0.6384, leads to the conclusion that there is a strong intensity of the relationship between the endogenous variables (interest rate and tax rate) and the exogenous variable (investment).

After testing the model's parameters, through t-Statistic, the following conclusions are obtained:

- The I_0 parameter has a t-Statistic of 23.21 and the Prob. of 0.0000 < 0.05, indicating that the parameter is significant
- The i_r parameter has a t-Statistic of -2.00 and the Prob. of 0.0465 < 0.05, indicating that the parameter is significant
- The I_0 parameter has a t-Statistic of -21.01 and the Prob. of 0.0000 < 0.05, indicating that the parameter is significant

3. RESULTS

After applying the multicollinearity tests, the F test for checking the validity of the model, the determination of the relationship's intensity between the registered variables, and the t-Statistics for testing the parameters, it can be stated that the proposed model is valid, and that the investments are determined by two factors: interest rate (inverse relationship) and tax rate (inverse relationship).

*I(r,TR) = 7072.95 - 17.94*R - 22323.88*TR,* where r – interest rate, TR – tax rate

For this study, the technical analysis indicator – Relative Strength Index (RSI) – was introduced. The Relative Strength Index, developed by J. Welles Wilder, is a momentum oscillator that measures the speed and change of value movements. RSI oscillates between zero and 100. Traditionally, and according to Wilder, RSI is considered overbought when above 70 and oversold when below 30. Signals can also be generated by looking for divergences, failure swings and centerline crossovers. RSI can also be used to identify the general trend.

$$RSI = 100 - \frac{100}{1+RS}$$, where RS = average gain/average loss

This indicator will be applied on the historic interest rates, tax rates, on the taxes' growth rate and on the GDP's growth rate. The resulting values are presented in the following table:

Table 6: The analysis of the investment, after applying RSI

YEARS	RSI_I	RSI_r	RSI_TR	RSI_dT	RSI_dGDP
01.01.2002	60.76	26.65	41.08	46.60	49.93
01.04.2002	62.16	27.48	39.90	49.36	48.67
01.07.2002	62.32	27.29	43.78	51.91	48.43
01.10.2002	63.15	26.79	43.40	49.54	46.47
01.01.2003	63.94	24.78	43.61	50.29	49.89
01.04.2003	64.51	24.59	41.56	48.93	49.70
01.07.2003	69.41	23.45	42.71	51.72	56.77
01.10.2003	73.98	23.78	45.06	51.50	51.23
01.01.2004	75.49	23.57	46.91	51.40	52.18
01.04.2004	79.79	24.68	46.00	49.87	52.03
01.07.2004	81.35	31.68	47.12	50.86	51.28
01.10.2004	83.25	38.46	43.79	48.51	52.49
01.01.2005	85.04	46.10	57.87	58.28	54.72
01.04.2005	82.85	51.25	56.62	48.93	48.15
01.07.2005	84.30	55.70	56.92	50.29	53.21
01.10.2005	86.84	60.08	56.51	49.52	49.92
01.01.2006	88.00	64.19	54.98	49.80	54.86
01.04.2006	88.28	66.71	52.33	48.40	48.80
01.07.2006	85.66	68.99	49.54	47.78	45.79
01.10.2006	79.26	68.55	48.80	49.36	48.70
01.01.2007	78.04	68.97	47.96	49.49	49.66
01.04.2007	79.94	67.20	52.25	52.55	51.76
01.07.2007	77.69	66.37	53.12	49.93	47.79
01.10.2007	70.69	53.27	48.06	46.79	46.81
01.01.2008	63.52	42.09	41.06	44.29	41.98
01.04.2008	60.52	32.71	30.39	40.25	48.24
01.07.2008	54.60	36.27	39.28	54.07	42.21
01.10.2008	40.05	31.24	34.54	43.62	32.14
01.01.2009	29.22	28.82	32.12	46.45	39.68
01.04.2009	26.07	29.15	26.26	42.91	45.32
01.07.2009	27.47	29.38	32.60	54.04	49.23
01.10.2009	34.02	28.82	35.49	52.73	52.37
01.01.2010	40.63	28.76	37.54	52.24	52.54
01.04.2010	46.41	30.17	36.94	50.13	50.86
01.07.2010	49.25	30.17	41.07	53.12	51.63

(Source: Personal Computation)

By analyzing the above table, the tendency for the following period of time, in terms of interest rates, is to increase, given the fact that nowadays there is an overselling of financial securities. In this situation, there is a negative effect on

investments, and this could lead to a new recession of the American economy, creating the prerequisites for this W crisis. To counter these negative effects, the federal government can use as an instrument the fiscal policy. Thus, reducing the tax rate is absolutely necessary in order to determine businesses to increase their investments, and by doing so, to escape this difficult period.

The tax rate is dependent on the taxes' growth rate and on the economic growth rate. Thus, it is necessary to reduce the tax level or to increase the rate up to a level that is lower than the economic growth rate; and this would have a positive effect on the economy. Furthermore, the reduction of taxation will lead to increased investments, which will further conduct to an increased income, and this, in turn, will cause investments to surge even further.

The proposed model identifies the targets that would be pursued by the tax system.

- If GDP increases → Taxes' growth rate < GDP's growth rate
- If GDP decreases → GDP's growth rate < Taxes' growth rate < 0

The proposed model is shown in the figure below.

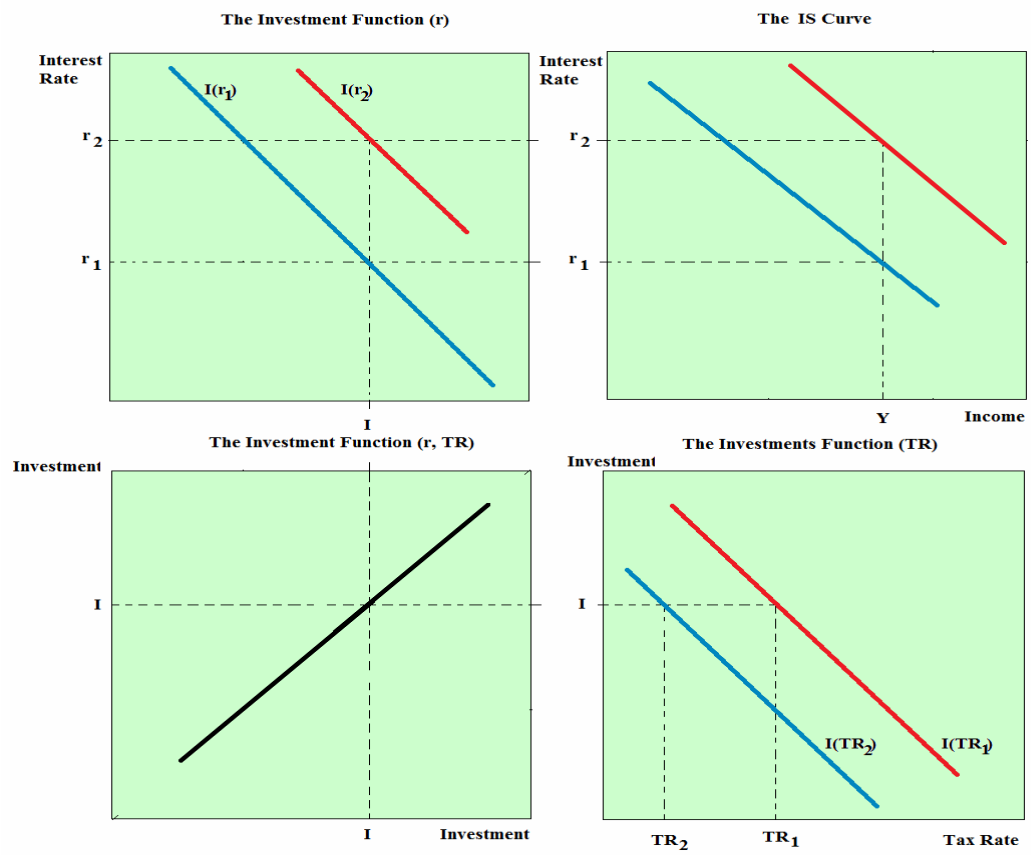

Figure 2. The Investment Function

Increasing the interest rate from r_1 to r_2 in the panel entitled *The Investment Function (R)* leads to a reduction in tax rates from TR_1 to TR_2 in *The Investment Function (TR)* panel. Finally, this reduction in tax rates leads to the displacement of the IS curve to the right (in the panel entitled *The IS Curve*), i.e. to a growth of the goods and services market.

4. Conclusions

The short-term model proposed by Mundell and Fleming, in terms of investment as a linear function dependent on the interest rate, is not a valid model in the long term. On a long term, the investments are dependent on interest rates and taxation levels, as measured by tax rate:

*I(r,TR) = 7072.95 - 17.94*R - 22323.88*TR, where r – interest rate, TR – tax rate*

The model proposed in this paper identifies a set of measures for the economy's revival, giving the difficult economic times we are experiencing. Due to the fact that the investments are determined through an inverse relationship with the interest rate and with the tax rate, the government has at its disposal the fiscal policy, through which it can determine the investment's growth, even in terms of higher interest rates.

Interest rates fell very sharply in the last two years as a result of the anti-crisis programs developed, thus in the following period of time, it can no longer be used as an effective tool to fight recession; and forecasts of technical analysis show that, in fact, it will further grow. Under these conditions, an efficient fiscal policy will determine an increasing of the investments and economic growth.

By analyzing the investment equation, it emerges the fact that the higher coefficient of TR, than that of R, determines a higher sensitivity of the changes in investment at the changes in taxation, rather than at the changes in interest rates.

In the next period, a new reduction of the tax rate is necessary and this can be done in two ways:

- Reducing taxes
- Increasing the taxes by a rate lower than the economic growth rate (GDP growth)

In order to avoid affecting the budget deficit, a measure with positive effects on the economy is to increase taxation, but with a lower rate than that of economic growth. This measure will lead to increased budgetary revenues and economic growth, as a result of increased investments. In this context, the proposed model represents a new approach to economic policy. Interest rate and tax rate should fluctuate in opposite direction, in order to achieve economic growth; and increasing interest rates may cause a fiscal policy decision to increase taxes, but with a lower rate than the rate of economic growth. In this context, it can be stated that the fiscal policy is an extremely valuable tool for the government.

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